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(54) **CONSTRUCTION VEHICLE FOR PREPARATION OF A ROAD SURFACE**

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E01C 23/12 (2006.01)

(52) **U.S. Cl.**
CPC ***E01C 23/088*** (2013.01); ***E01C 23/127*** (2013.01); *E01C 2301/00* (2013.01)

(58) **Field of Classification Search**
CPC E01C 23/127; E01C 2301/00
USPC 299/39.1, 39.4, 39.5, 39.6, 39.7
See application file for complete search history.

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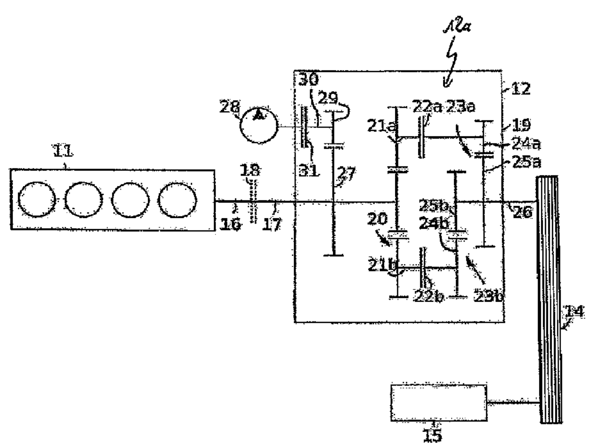
(57) **ABSTRACT**

The invention relates to a construction vehicle for preparation of a road surface, more particularly a road milling machine or a ground stabilizer, comprising a rotatably driven milling cutter, more particularly a milling rotor or a milling drum, and a drive unit for a milling tool, comprising a drive motor and a gear unit interposed between the drive motor and the milling cutter, wherein the gear unit is in the form of a cogwheel gearbox and comprises at least two gear pairings having different gear ratios, wherein the gear pairings can be selectively engaged to form part of the drive connection or disengaged therefrom.

7 Claims, 3 Drawing Sheets



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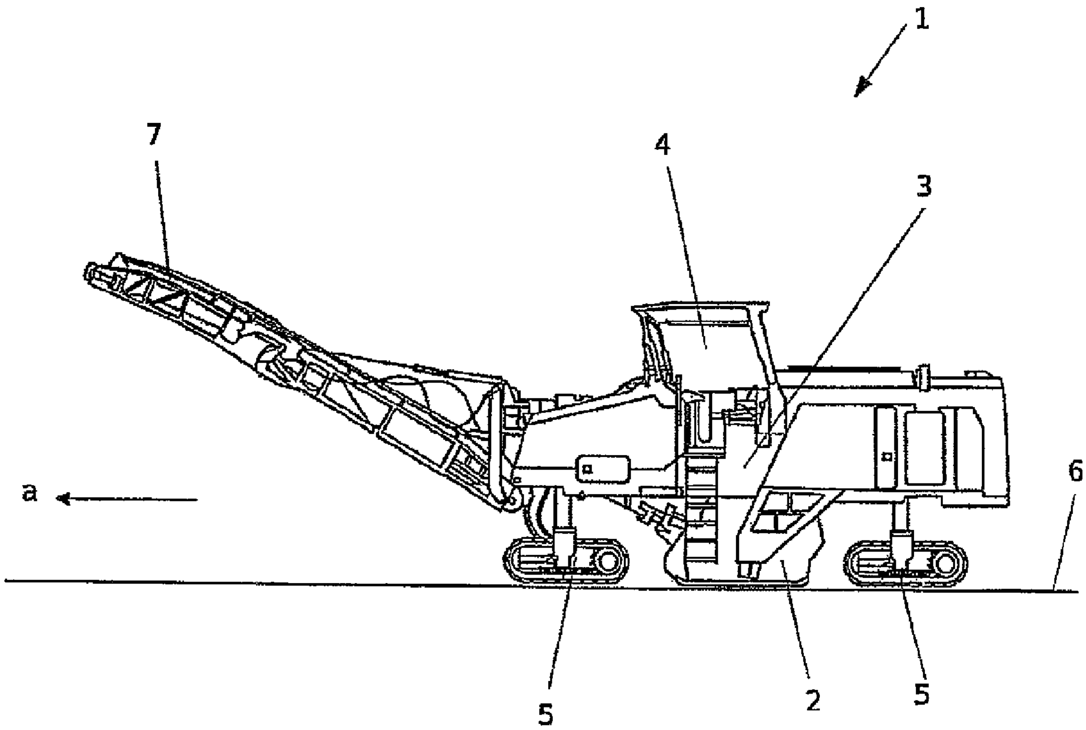
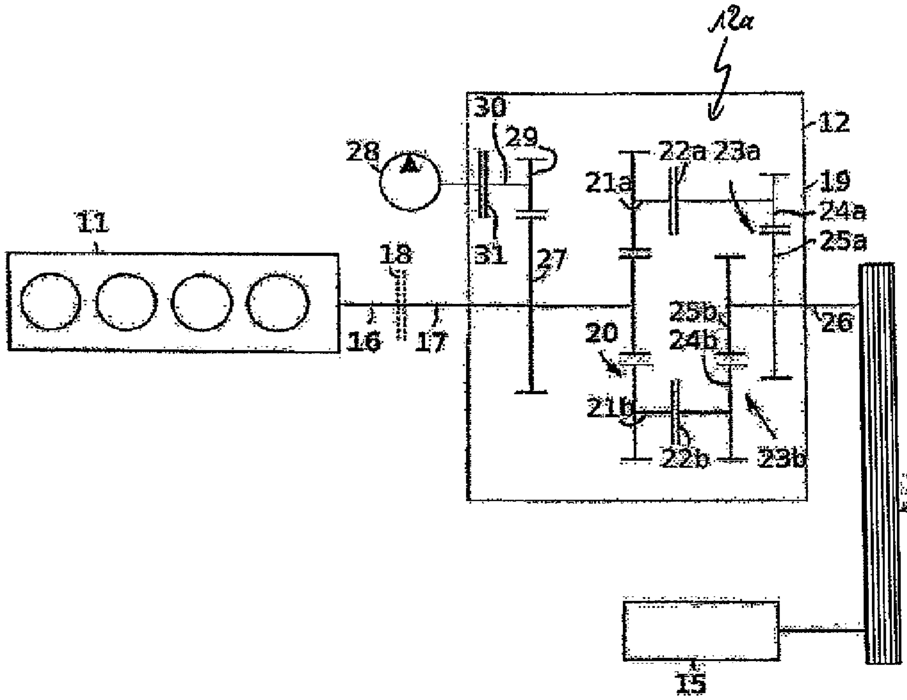


Fig. 1



12a
12
30
29
28
22a
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21a
19
24a
25a
11
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31
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25b
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24b
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21b
22b
23b
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Fig. 2

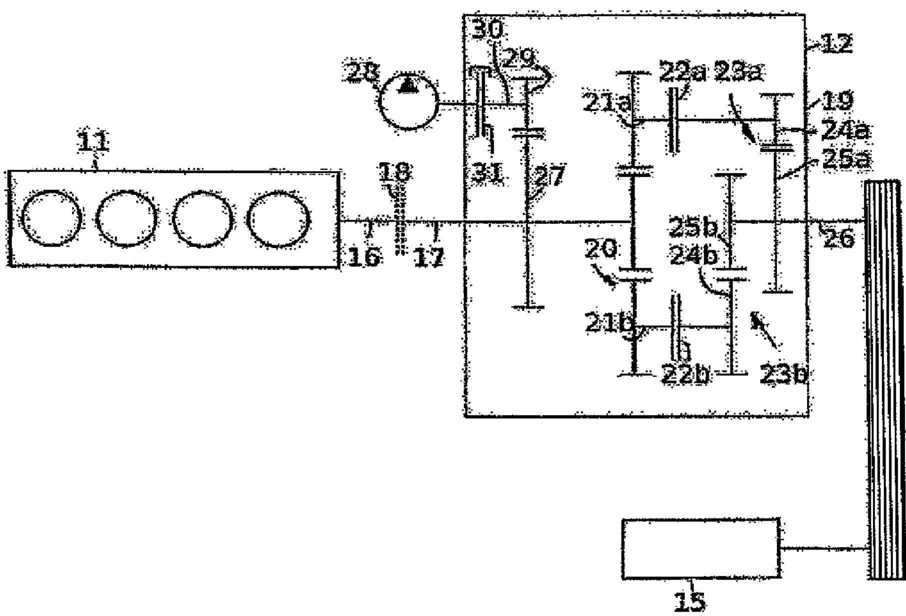

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Fig. 3

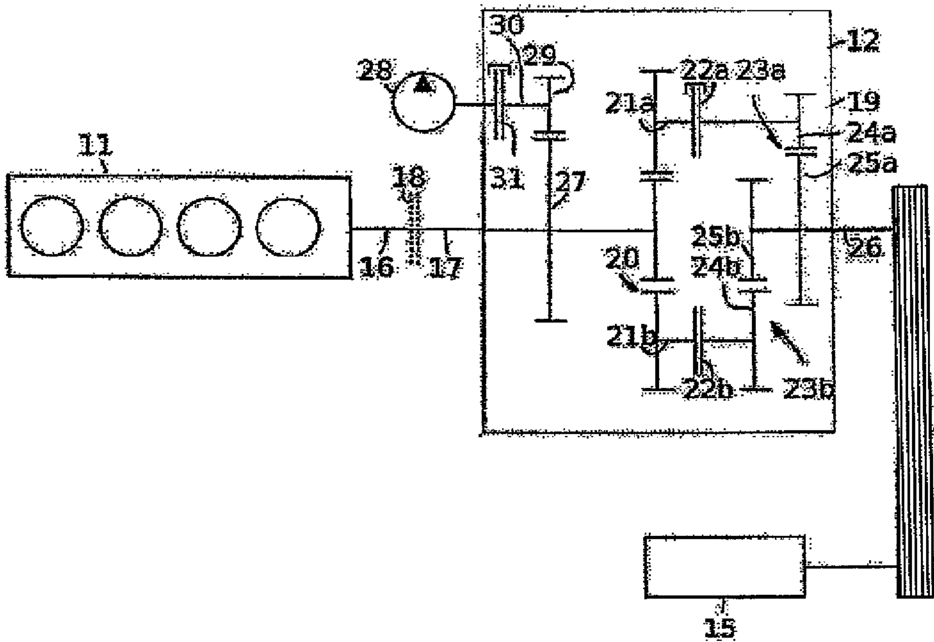

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Fig. 4

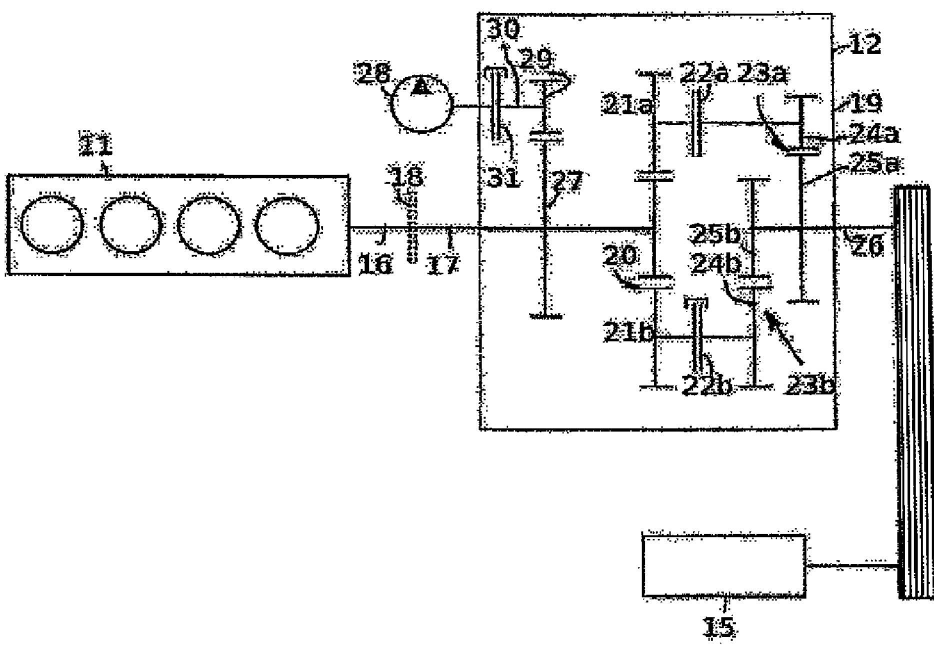

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Fig. 5

CONSTRUCTION VEHICLE FOR PREPARATION OF A ROAD SURFACE

CROSS-REFERENCE TO RELATED APPLICATIONS

The present application claims priority under 35 U.S.C. §119 of German Patent Application No. 10 2012 009 310.1, filed May 10, 2012, the disclosure of which is hereby incorporated herein by reference in its entirety.

FIELD OF THE INVENTION

The present invention relates to a construction vehicle for preparation of a road surface, in particular, a road milling machine.

BACKGROUND OF THE INVENTION

An example of such a construction vehicle is disclosed in DE 20 2007 010 294 U1. The latter comprises a milling drum mounted on a vehicle frame and driven by a diesel engine. Disposed downstream of the diesel engine is a transmission for transferring the drive power to the milling drum and to other transmissions connected in parallel.

A fundamental problem with such construction vehicles relates to the extremely high degree of oscillation, vibration, or shaking which is generated by the milling tool and is referred to below in general as "vibration". This vibration can spread to substantially the entire construction vehicle unless damping measures are taken. Thus, individual measures aimed at decoupling individual vehicle components from the milling tool are always taken. For example, DE 10 2007 028 812 A1 concerns the decoupling of the driver's cab from the vibration generated by the milling tool.

The vibration produces a considerable amount of stress on the vehicle components. In order to ensure the durability of the drive motor, hitherto an attempt has always been made to decouple the drive motor as far as possible from the milling tool in terms of vibration. A currently widespread option is the use of a pump transfer gear, as described in the aforementioned document DE 20 2007 010 294 U1. The transmission of drive power between the drive motor and the milling tool is then achieved, at least partially, exclusively via the hydraulic pressure of a hydraulic fluid. The known damping properties of such a hydraulic fluid are then sufficient for adequately damping critical vibration.

The use of pump transfer gears is still widespread. This may be due to the fact that with such a pump transfer gear, a power take-off is easily engaged by operatively connecting other hydraulic motors. The disadvantages of such pump transfer gears, however, reside in the fact that their efficiency is somewhat poor as well as in the fact that fluid is lost resulting from leakages inherent to such a transfer gear. The leakages furthermore prevent precise speed synchronization between individual drives. Moreover, a pump transfer gear is expensive to purchase and maintain. Only pump transfer gears having a rigid gear ratio are acceptable in terms of purchasing and maintenance costs.

SUMMARY OF THE INVENTION

Thus the object of the present invention is to provide an improved construction vehicle of the aforementioned type and thus to reduce costs in terms of the drive connection and/or to reduce the aforementioned disadvantages of the prior solutions as far as possible.

One aspect of the present invention lies, in particular, in the use of a standard cogwheel gearbox by means of which the gear ratio between input and output can be varied. Furthermore, such a cogwheel gearbox readily permits the operative connection of auxiliary units. Especially when use is made of vibration damping means in the drive train, e.g., a belt drive interposed between the transmission and the milling tool, it is no longer absolutely necessary to use a pump transfer gear in order to ensure vibration decoupling between the milling tool and the drive motor. Such a cogwheel gearbox can be purchased and maintained at considerably lower expense than a pump transfer gear. In addition, the use of a cogwheel gearbox offers the advantages now described below.

Depending upon the gear selected, satisfactory to good speed variability of the milling drum along with very high efficiency of the completely mechanical drive are achieved. The possibility of operating the drive motor with optimized efficiency is, at comparably low purchasing and maintenance costs, to a large extent independent of the speed of the milling tool required for the operation. Compared with a fully variable drive, the cogwheel gearbox is considerably more economical to produce. The entirely discrete gear stages are admittedly valid arguments against the use of a cogwheel gearbox. Compared with earlier models, however, the improved milling tools available today permit operation within a certain speed range, such that this disadvantage no longer precludes the use of a cogwheel gearbox. Furthermore, the cogwheel gearbox also offers the possibility of readily engaging and/or disengaging power take-offs.

The speed of the milling tool can be varied quickly and conveniently, more particularly during operation and especially under load. To this end, the cogwheel gearbox may be provided with different gear stages between an input shaft and an output shaft, which can be selectively used for power transmission. A clutch associated with the respective gear can be used for engaging or disengaging a gear stage (gear pairing).

In one embodiment, a first clutch is associated with the first gear pairing and a second clutch is associated with the second gear pairing, wherein by engaging one of the two clutches, the respective associated gear pairing can be selectively engaged to form part of the drive connection or disengaged therefrom. In this case, for example, two gears of a gear pairing are always in mesh with each other. The effective engagement of this gear pairing in the drive train is then achieved by actuating the corresponding clutch, analogous to a dual clutch transmission as used in the automobile industry. The advantage of this resides in the fact that changing the gear ratio is possible without interrupting the drive power. This aspect of using a dual clutch transmission can of course also be applied in case of more than two gears, which is thus comprised by the present invention. The essential advantage of the present invention resides in the fact that this dual clutch transmission can be engaged and disengaged without interrupting the tractive power and therefore allows for particularly harmonic engagement and disengagement procedures. The basic principle of the dual clutch transmission can thus be summed up to the drive train having two sub-transmissions with two clutches which alternately provide for force transmission. If one clutch engages during working operation, the other clutch will open and vice versa.

The clutches associated with the respective gear pairings are preferably connected in parallel to each other. As intended, the drive connection between the drive motor and the output shaft of the transmission unit is then interrupted exclusively via these clutches. The advantage of such an arrangement is that the clutches required for engagement are essentially the same as those by means of which the drive connection can be fully interrupted. There is then no need for a separate "pre-clutch" between the drive motor and the transmission unit.

Alternatively, a gear stage can also be engaged by bringing the two gears of the respective gear stage into mesh with each other. However, this requires a brief interruption of the drive power, for instance via a clutch disposed upstream of the entire transmission. Changing the gear ratio, however, does involve an interruption of the drive power.

By selecting the right gear ratios, it is possible to ensure a nearly, or at least sufficiently, steady operation of the drive motor, thus operating the latter as far as possible in its optimum efficiency range.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be explained in more detail in an exemplary and non-restrictive manner, with reference to the figures, in which:

FIG. **1** is a diagram of a ground milling machine in its entirety;

FIG. **2** is a diagram of a milling rotor driving mechanism comprising a main drive and a power take-off in neutral;

FIG. **3** is a diagram of the milling rotor driving mechanism as shown in FIG. **2** with the main drive in neutral and the power take-off engaged;

FIG. **4** is a diagram of the milling rotor driving mechanism as shown in FIG. **2** with the main drive engaged and the power take-off engaged in a first gear stage; and

FIG. **5** is a diagram of the milling rotor driving mechanism as shown in FIG. **2** with the main drive engaged and the power take-off engaged in a second gear stage.

DETAILED DESCRIPTION OF THE INVENTION

FIG. **1** is a side view of a ground milling machine **1** (more specifically a front-end loader type road milling machine with a central rotor). The machine direction (forward direction) is indicated by the arrow "a". Essential elements of the ground milling machine include a milling device mounted in a drum housing **2**, a vehicle frame **3** with a driver's station **4** and caterpillar tracks **5** mounted in a vertically adjustable manner on the vehicle frame **3** by means of lifting columns (alternatively, use can also be made of wheel driving units). The ground milling machine **1** further comprises a driving mechanism for a milling rotor, which will be explained in more detail below. The milling rotor driving mechanism is equipped with an internal combustion engine not indicated in any greater detail, by means of which the necessary mechanical working energy for operation is supplied. In the working mode, the ground milling machine **1** is driven over the road surface **6** in the machine direction "a" and grinds up road surface material with a milling rotor (not illustrated in FIG. **1**) disposed within the drum housing **2**.

FIGS. **2** to **5** illustrate the milling rotor driving mechanism diagrammatically. A diesel engine serves as a drive motor **11**, the output shaft **16** of which is connected to an input shaft **17** of a cogwheel gearbox **12** for joint rotation therewith.

The drive torque is transferred via a pre-stage **20** to a first and second intermediate shaft **21***a*, **21***b*, in each case at the same gear ratio. A first multi-plate clutch **22***a* connects to the first intermediate shaft **21***a;* a second multi-plate clutch **22***b* connects to the second intermediate shaft **21***b*. The multi-plate clutches **22***a,* **22***b* are each used for engaging a first or a second gear stage **23***a*, **23***b* respectively. The two gear stages **23***a*, **23***b* each comprise an input pinion gear **24***a*, **24***b*, which are connected on the output side to the associated multi-plate clutch **22***a*, **22***b*. The two input pinion gears **24***a*, **24***b* mesh with output pinion gears **25***a*, **25***b*. The two gear stages **23***a*, **23***b* thus have different gear ratios. The two output pinion gears **25***a*, **25***b* are each fix-connected to an output shaft **26** of the cogwheel gearbox **12**. The output shaft **26** in turn drives a belt drive **14**, which finally drives the milling drum **15**.

Furthermore, an auxiliary unit **28**, for example, a generator or a hydraulic pump, is driven by the input shaft **17**. To this end, the input shaft drives a pinion gear **27**, which continuously meshes with another pinion gear **29**, thereby continuously driving an auxiliary shaft **30**. A cut-in clutch **31** for engaging the auxiliary unit **28** connects to this auxiliary shaft **30**.

In the state illustrated in FIG. **2**, the input shaft **17**, the two intermediate shafts **21***a*, **21***b*, and the auxiliary shaft **30** are being driven. The input pinion gears **23***a*, **23***b* of the gear stages, however, are not being driven at this moment, since the multi-plate clutches **22***a* and **22***b* are disengaged. In order to drive the milling drum **15**, one, and only one, of the gear stages **23***a*, **23***b* must be engaged in the drive train. To this end, only one of the two multi-plate clutches **22***a*, **22***b* is engaged. It can be seen that the gear ratio between the input shaft **17** and the output shaft **26** is established by selecting one of the multi-plate clutch elements **22***a*, **22***b* for engagement.

Unlike FIG. **2**, FIG. **3** shows that the cut-in clutch **30** is now engaged. In this state, the milling drum **15** is not being driven, whereas the auxiliary unit **28** is.

Unlike FIG. **3**, FIG. **4** shows that the first multi-plate clutch **22***a* is now engaged, thereby establishing a drive connection between the diesel engine **11** and the milling drum **15**. The first gear pairing of the input pinion gear **24***a* and the output pinion gear **25***a* of the first gear stage **23***a* are now part of the drive connection.

Unlike FIG. **4**, FIG. **5** shows that the second multi-plate clutch **22***b* rather than the first multi-plate clutch **22***a* is engaged. Thus the drive connection between the diesel engine **11** and the milling drum **15** is still established, but with a different gear ratio. The second gear pairing of the input pinion gear **24***b* and the output pinion gear **25***b* of the second gear stage **23***b* are now part of the drive connection.

The drive connection between the output shaft **16** of the drive motor **11** and the output shaft **26** of the transmission **12** can be interrupted or established via the selectively engagable clutches **22**. A shifting clutch between the drive motor **11** and the transmission **12**, which is represented in the figures by dotted lines outside the transmission housing **19** and is designated by the reference numeral **18**, is therefore unnecessary. Furthermore, this enables variation of the gear ratio without interrupting the traction force, so that an optimized gear ratio is provided depending on the application. Moreover, the number of gear pairings can be extended beyond the pairings indicated in the figures, so that the differences between the gear stages can be reduced, enabling optimized operation of the drive over a broad range of different rotational speeds of the milling drum.

Ideally, the multi-plate clutches **22***a*, **22***b* are connected functionally, for example, in such a manner that the clutches are prevented from both engaging simultaneously. Accordingly, the connection occurs in such a manner that only clutch **22***a*, or only clutch **22***b* respectively, is engaged while the respective other clutch is disengaged. This is achieved, in particular, by the configuration of dual clutch transmission **12***a*.

While the present invention has been illustrated by description of various embodiments and while those embodiments have been described in considerable detail, it is not the intention of Applicant to restrict or in any way limit the scope of the appended claims to such details. Additional advantages and modifications will readily appear to those skilled in the art. The invention in its broader aspects is therefore not limited to the specific details and illustrative examples shown and described. Accordingly, departures may be made from such details without departing from the spirit or scope of Applicants' invention.

What is claimed is:

1. A road milling machine or a ground stabilizer, comprising:

a rotatably driven milling cutter; and

a drive unit for said milling cutter comprising a drive motor and a gear unit interposed between said drive motor and said milling cutter,

wherein said gear unit is in the form of a cogwheel gearbox and comprises at least two gear pairings having different gear ratios, wherein the at least two gear pairings can be optionally engaged to form part of a drive connection or disengaged therefrom with a first clutch being assigned to a first of the at least two gear pairings and a second clutch being assigned to a second of the at least two gear pairings, wherein the act of closing one of the at least two clutches causes the respectively assigned first or second gear pairing to be engaged to form part of the drive connection and the other one to be disengaged therefrom so that the speed of the milling cutter can be varied during operation and under load.

2. The road milling machine or ground stabilizer according to claim **1**, wherein the drive unit comprises a dual clutch transmission.

3. The road milling machine or ground stabilizer according to claim **1**, wherein the first and second clutches respectively assigned to said first and second gear pairings are connected in parallel and the drive connection between said drive motor and an output shaft of said gear unit can be interrupted exclusively via said first and second clutches.

4. The road milling machine or ground stabilizer according to claim **1**, wherein a torsion vibration damper is disposed between said gear unit and said milling cutter.

5. The road milling machine or ground stabilizer of claim **4**, wherein the vibration damper comprises a belt drive.

6. The road milling machine or ground stabilizer of claim **1**, wherein the rotatably driven milling cutter comprises a milling rotor.

7. The road milling machine or ground stabilizer of claim **1**, wherein the rotatably driven milling cutter comprises a milling drum.

* * * * *